MONASH University
Engineering

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Higher Degree by Research @ Department of Mechanical Engineering

Presentation Outline

- **Research groups within the Department of Mechanical Engineering**
- **Research opportunities**
- **Research projects conducted by Masters/PhD students**
- **Employment Statistics of Masters/PhD graduates in Australia**

Research Groups with Mechanical Engineering

- **Aeronautical and industrial fluid dynamics (FLAIR)**
- **Aerospace, turbulence and combustion (LTRAC)**
- **Automotive (CRC Advanced Automotive Technology)**
- **Composite structures (CRC for Advanced Composite Structures)**
- **DSTO Centre of Expertise (Structural Mechanics)**
- **Industrial engineering management**
- **Integrated Engineering Asset Management (CIEAM)**
- **Maintenance technology (MTI)**
- **Micro\nano solid and fluid mechanics (MNRL)**
- **Railway technology (CRC for Rail Technology and IRT)**
- **Robotics and mechatronics (RMRL)**

What are the opportunities for research in Mechanical Engineering?

- **Fluid mechanics & Aerodynamics**
- **Bioengineering/nanotechnology**
- **Environmental Engineering**
- **Structures (aerospace, automotive, maritime, rail)**
- **Thermodynamics & Heat Transfer**
- **Robotics and Mechatronics**

Employment Statistics of Masters/PhD In Australia

In 2005, survey shows that;

81% of Masters/PhD graduates obtained full-time employment

Top 3 occupations are:

51.7% Engineering Professionals

13.8% Med/Sci Tech Officers

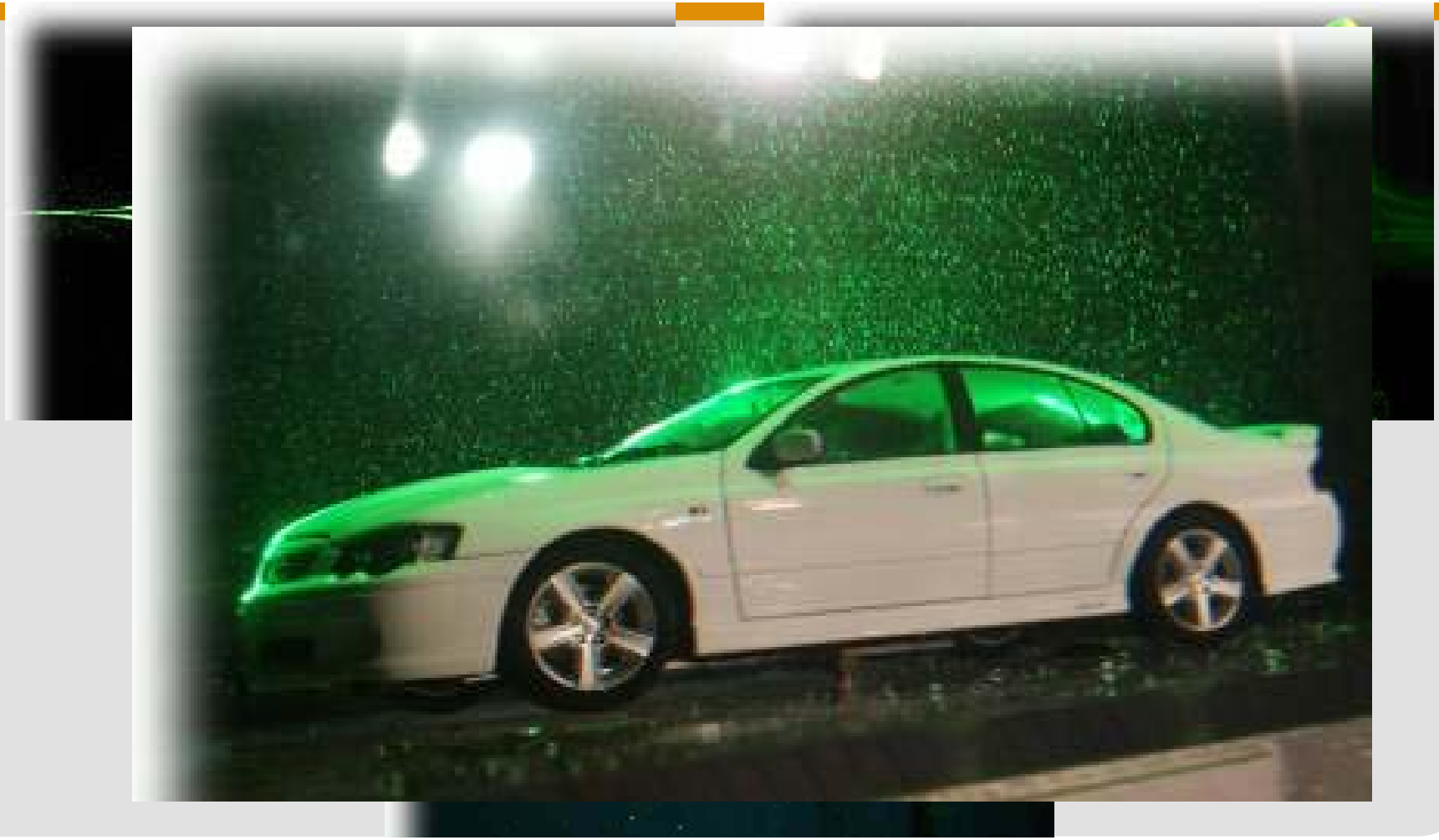
10.3% Teaching Professionals

Source of information: Graduate Careers Australia

Graduates and where they are now

Australian Maritime Offshore Group;
Boeing Australia;
CSIRO;
Department of Defence;
General Motors Holden;
Shell (Asia Pacific);
Queensland Rail;
VPAC;
VIPAC;
Worley;

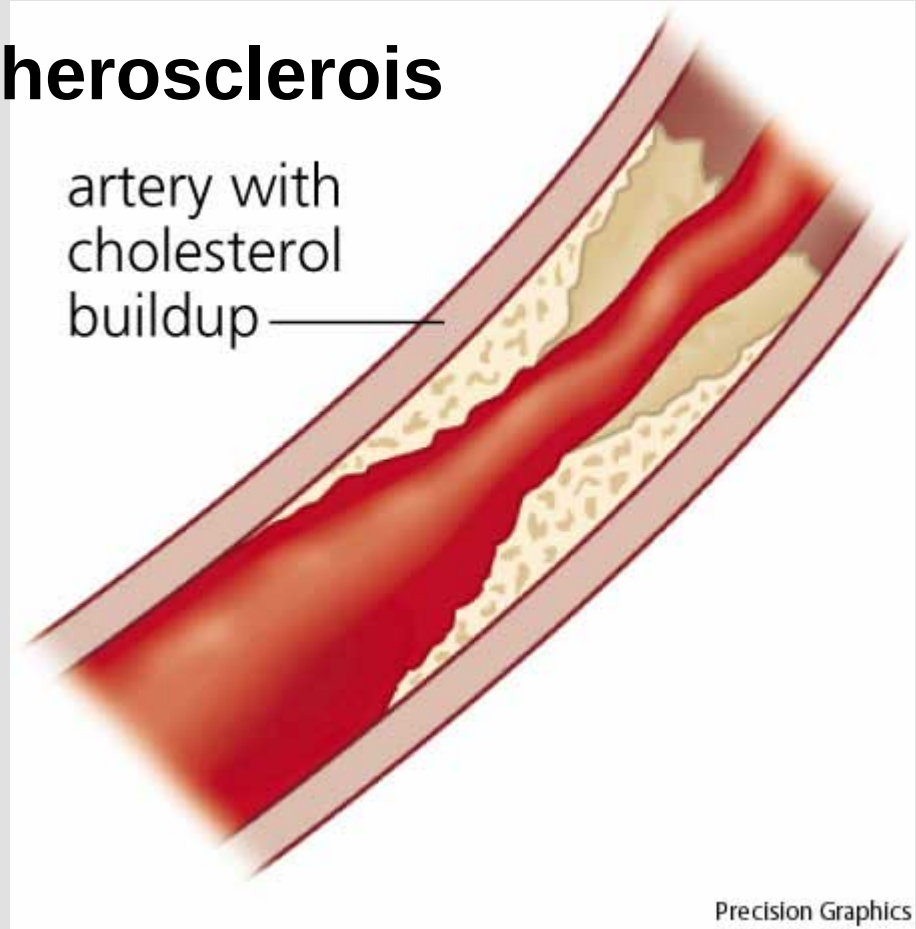
Fluid mechanics and aerodynamics



Fluid mechanics and aerodynamics

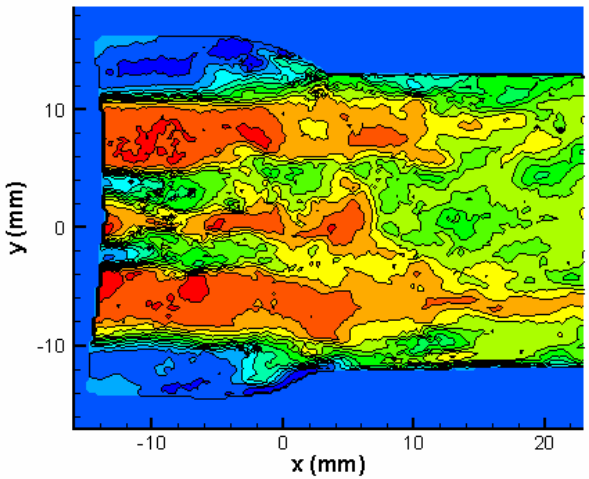
Arterial Disease - Atherosclerois

- **Vessel blockage**
  - Plaque
  - Rupture → heart attacks & strokes
- **Modified flows**
- **How do modified flows change clotting function?**
- **Contribute to plaque rupture?**



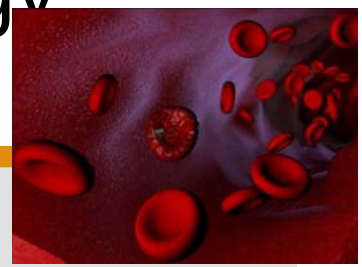
Fluid mechanics and aerodynamics

Mechanical Heart Valves



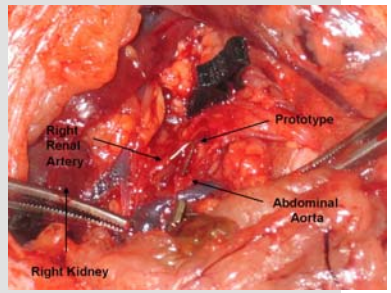
- **Flow through mechanical valve**
- **Identify flows damaging to red blood cells & platelets**
- **Valve design**

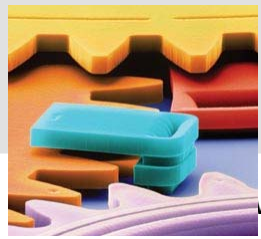
Bioengineering/nanotechnology



•Research Activities and Possible PhD Projects

- Acoustic/Electrohydrodynamic micro/nanoparticle, fiber and aerosol generation
  - Development of a new miniature aerosol generation mechanism for pulmonary delivery of insulin
  - Fundamental studies of drop breakup from acoustically excited capillary wave instabilities
  - Haemoglobin encapsulation for the development of artificial blood substitutes
  - Biomaterials synthesis for tissue/orthopaedic engineering and wound care therapy
- Vortex generation through acoustic and electrical fields
  - Blood/plasma separation in miniature medical diagnostic kits
  - Efficient micro-mixing for high throughput drug screening
  - Bacteria/virus trapping for early warning dectection systems (biosensors)
- Fluid transport via electrohydronamic or acoustic mechanisms
  - Development of laser projection systems using electrowetting
  - Fast bubble/drop transport by acoustic wetting
- Micro/nano-electro-mechanical devices
  - Robotic micromanipulation of human eggs and sperm for automated IVF
  - Torsional micro-motors for robotic neurosurgery
  - Arterial reflow stent design
- Nanoscale phenomena
  - Flows through surface functionalised carbon nanotubes



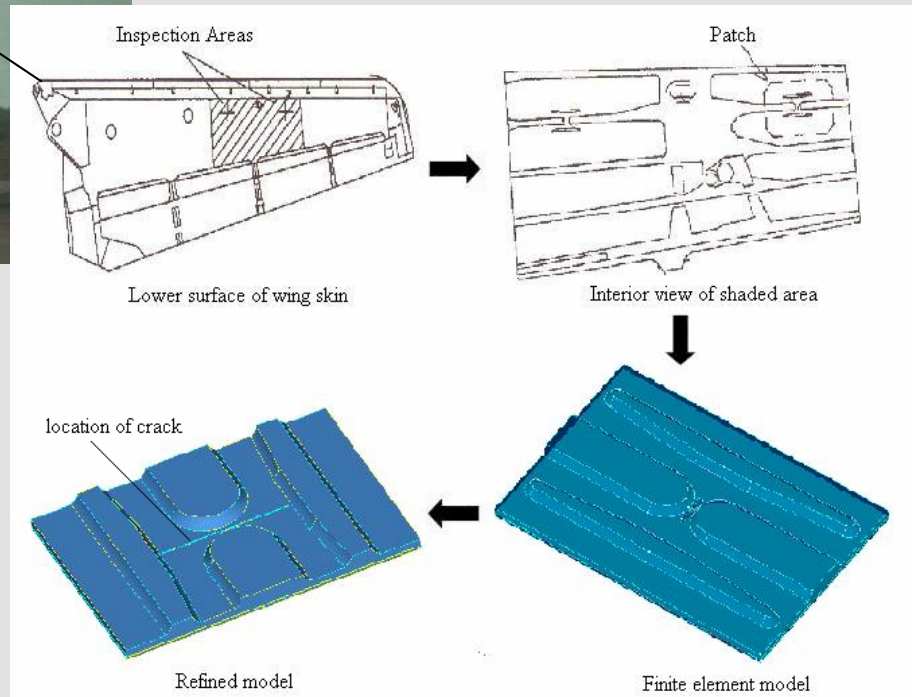


Environmental Engineering

Researching the changes in tidal estuaries over 1000s of years by numerical modelling and targeted field studies. These studies suggest that the non-linear dynamics of these systems creates attractors towards which the estuary evolves or about which it varies. One attractor is the relationship between channel cross section and tidal currents, another is the occurrence of a preferred depth during the filling of tidal lakes, as in this photo.

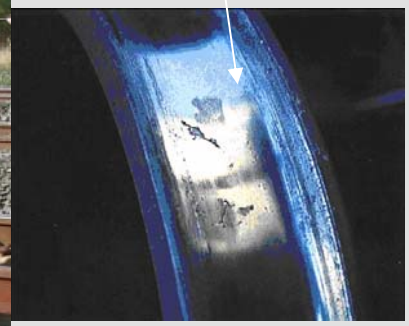
Structures
(aerospace, automotive, maritime, rail)

Development of in-situ structural health monitoring methodology



Structures
(aerospace, automotive, maritime, rail)

Wheel defects

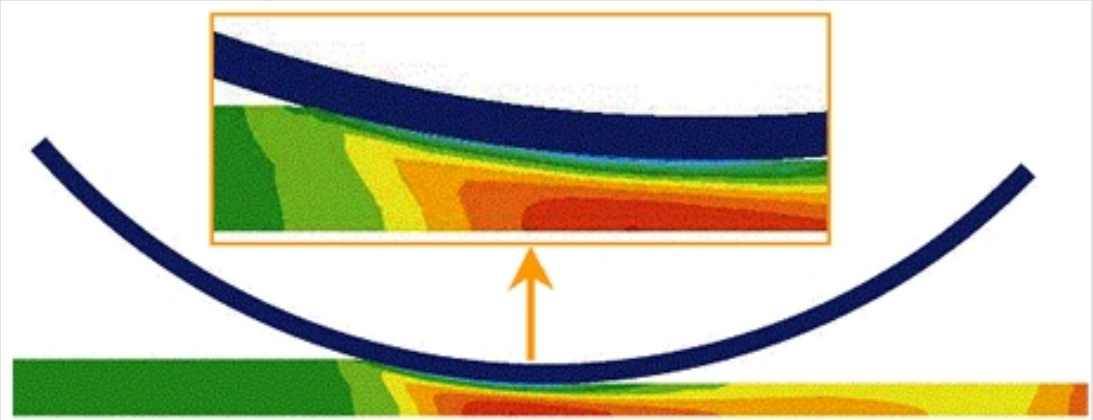


Instrumented site at Lara (Geelong) to substantiate model prediction and algorithm

Structures
(aerospace, automotive, maritime, rail)

Processing of Aluminium Alloys

- **Research to develop models for predicting property-microstructure-deformation for industrial hot rolling processes**
- **Also to develop models for improving and controlling smelting, casting and extrusion processes.**
- **Research supported by industries: Alcoa, KAAL, Comalco, Commonwealth Aluminium, Hulett Aluminium**



Thermodynamics & Heat Transfer

- **Fluid flow and heat transfer in cross-corrugated plate heat exchangers.**
- **Energy analysis in power production**
- **Energy conservation, efficiency improvement and CO2 abatement**
- **Refrigeration and air-conditioning**
- **Solar water desalination**
- **Renewable energy**